

Effect of Knowledge and Attitude toward Sun Exposure Related Vitamin D to Lung Function

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ABSTRACT

Indonesia is a country with a tropical climate with sun exposure throughout the season, because sunlight is the largest source of vitamin D. The risk of vitamin D deficiency can lead to respiratory problems. With good self-management, of course, adequate knowledge and attitudes are needed in overcoming various individual health problems. The purpose was to influence knowledge and attitudes towards sun exposure in meeting the need for vitamin D to improve lung function in healthy respondents without chronic respiratory disorders. The research will be conducted using a cross sectional design, in May-August 2019. The variables were knowledge and attitudes towards sun exposure related to the risk of vitamin D deficiency and lung function by forced expiratory volume in 1 second (FEV1) and forced vital capacity (FVC). Respondents used in this study were 168 respondents. Most of the respondents had good level of knowledge (97 of 168), and most of the respondents had good level of attitude (115 of 168). There was relationship between the level of knowledge ($p=0.000$) and attitude ($p=0.000$) toward sun exposure levels related to vitamin D and lung function. And there was relationship between the level of knowledge to attitude on sun exposure levels related to vitamin D ($p=0.000$). Therefore, knowledge and attitudes on sun exposure related to vitamin D were important concerns to maintain healthy lung function.



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1. INTRODUCTION

Indonesia is in a tropical climate region with sun exposure throughout the season. Sunlight can produce ultraviolet rays that cannot be seen by the eyes directly, but have benefits for the body [1], [2]. The effects that can be felt from sun exposure can be seen in the short term and long term. Effects that can be caused in the short term such as erythema, photosensitivity and pigmentation are acute. The long-term effects include skin cancer and premature aging [3]. Previous research showed that vitamin D levels were less than 50 nmol/L in participants who still had Indian, Malay and Chinese ancestry [4]. Research in Indonesia shows that many people experience vitamin D deficiency from various backgrounds and ages [2], [5- 8]. Sun exposure is the largest source of vitamin D which is very beneficial for the body apart from food sources

and supplements [9]. Vitamin D consists of two types, namely D2 or ergocalciferol and vitamin D3 or cholecalciferol. Vitamin D2 or ergocalciferol can be obtained from supplements and food [10]. Vitamin D3 or cholecalciferol is produced from the synthesis of 7-dehydrocholesterol obtained from sunlight and can be obtained by consuming milk, supplements, yogurt, fish oil, cereals and margarine. Vitamin D which is produced from sunlight, namely UVB rays, has benefits for bone formation and reduces the risk of diseases including arthritis, skin cancer and autoimmune diseases [11], [12].

Although Indonesia is a country that has a great opportunity to be exposed to sunlight, it has a low risk of vitamin D status. Low levels of vitamin D can be influenced by skin color, age, and gender [13]. The risk of vitamin D deficiency can lead to respiratory problems. There's a relationship between vitamin D deficiency related to respiratory disorders such as chronic obstructive pulmonary disease (COPD), tuberculosis and asthma. Respiratory disorders that occur in a person are caused by the immune system in the body inhibiting the production of cytokines, thereby reducing inflammation [14- 16]. Vitamin D which is present in one of the respiratory systems, namely the lungs, will have the effect of changing T cell activity, increasing the secretion of antimicrobial cathelicidin peptide, producing chemokines and inhibiting dendritic cell activity. This effect is used to fight infections that can cause lung diseases. If the level of vitamin D in smokers is low, the damage to lung function will be faster [15- 17].

Respiratory disorders that occur greatly affect the quality of life of every affected community [18]. So to improve the quality of life of the community in the health sector and in an effort to prevent the incidence of illness, the government through the health department plans a healthy community movement by making 7 main agendas such as maintaining environmental cleanliness, consuming fruit and vegetables, not consuming alcohol, not smoking, doing physical activity, check their health regularly and maintain the cleanliness of the latrines [19]. This program will never be implemented properly without self-management from within each individual such as controlling thoughts, emotions, behavior and being able to motivate oneself to achieve goals in improving one's own health [20]. With good self-management, of course, adequate knowledge and attitudes are needed in overcoming various individual health problems [21]. The of individuals have less knowledge and attitudes towards health problems. The relationship between knowledge and attitudes related to decreased lung function is very low due to several factors such as education level and living environment [22]. Therefore, this study aimed to influence knowledge and attitudes towards sun exposure in meeting the need for vitamin D to improve lung function in healthy respondents without chronic respiratory disorders.

2. METHODS

The research will be conducted using a cross sectional design, by giving a questionnaire to each respondent to measure differences in knowledge and attitudes related to sun exposure, in May until August 2019. The variables of this study were the level of knowledge and attitudes towards sun exposure related to the risk of vitamin D deficiency and lung function by forced expiratory volume in 1 second (FEV1) and forced vital capacity (FVC). This research had received ethical test No.004-OL/KE/V/2019 from Universitas Surabaya. Lung function referred to in this study is how well the ability to move air in and out of the lungs and how well oxygen enters the body. Lung function can be measured through spirometry measurements by looking at the FEV1/FVC value, where an FEV1 value of <70% can be said to have impaired lung function. The value of FEV1/FVC is good if the results show ≥ 0.7 [23], [24]. The requirements that must be considered by each respondent before pulmonary function tests are carried out are as follows: No smoking for an hour before test; Didn't consume alcohol for the previous 4 hours before test; Not doing sports activities for the previous 30 minutes before test; Didn't eat for 2 hours before test; Didn't wear tight clothes; and No medication was taken before [25]. Measurement of lung function using a handheld spirometer where body

mass index (BMI) data in the form of weight and height and respondent data in the form of gender, age, smoker or not are entered into the spirometer. Then the respondent was asked to stand or sit up straight, then the respondent is asked to inhale as deeply as possible through the mouth while closing the nose, then the tube contained in the spirometer is inserted into the mouth, making sure the lips tightly cover the tube wall and the tongue does not cover the tube opening, then breathe out. Exhale as hard and fast as possible in one second until there was no air left in the lungs. Examination with a spirometer can be done 3 times or more to get more accurate results. The results of the spirometer measurement from the respondent will determine whether the respondent has respiratory problems or does not experience respiratory problems based on the FEV1 value. FEV1 value <70% already indicates respiratory problems. So if the value of FEV1 <70%, then it is categorized in the group of respiratory disorders and FEV1 70% is categorized in the group that does not experience respiratory disorders [24], [26], [27].

The knowledge data collection was carried out using a questionnaire that has been used in previous studies [8], [29- 31]. The questions in the questionnaire consist of 11 questions that were structured in the form of open-ended questions and closed-ended questions. The type of data used in this variable used ordinal variable. The assessment of the level of knowledge of the respondents was carried out by calculating the total score of correct answers to each question, each correct answer will be given a score of 1, so that the maximum total correct answer of the respondent is a score of 11. In this study the level of knowledge was categorized into 2, namely the level of knowledge was high if the number was correct 6 items and low level of knowledge if the number of correct answers <6 items.

The attitude data collection was carried out using a questionnaire that has been used in previous studies [8], [29- 31]. The questions in the questionnaire consist of 9 questions that were used to determine attitudes towards sun exposure. The types of data used in this study were ordinal and nominal variables. In this study, the assessment of attitudes related to sun exposure was divided into 2 categories consisting of good attitudes and bad attitudes. Each question asked will be given a score of 2 if the research subject had an attitude that tends to be at risk of vitamin D deficiency. This questionnaire can produce a maximum score of 18 points, if the respondent's answer produces 9 points then it can be categorized as a good attitude, but if >9 points then respondent's attitude was categorized as bad.

The research subjects were young people (≥ 18 years) as students in the Rungkut District, Surabaya. Sampling technique was done by purposive and consecutive sampling method. The sample size formula that will be used in this study was Lemeshow because it does not know the previous sample population. So the minimum respondents who will be used in the study are 62 respondents. In this study, the questionnaire used was a previous research questionnaire which had been validated twice. The first validation used was content validation, where the questionnaire that has been obtained from the journal was translated into Indonesian first. The second validation was construct validation, where the questionnaire will be distributed to 30 students at the University of Surabaya after which data processing will be carried out using SPSS version 24 software. Reliability was the stability of the results to the extent that a questionnaire that has been measured repeatedly with any method will produce the same results. Reliability was carried out on 20-30 subjects and not included in the sample, then it would be analyzed using the Cronbach's alpha method in the SPSS software.

Data analysis to examine the relationship of knowledge and attitudes on sun exposure related to vitamin D on lung function (ratio FEV1/FVC) using chi-square test. Then the test was also used to analyze the relationship between knowledge and attitudes on sun exposure levels related to vitamin D.

3. RESULTS

3.1 Validity and reliability test results

In testing the validity and reliability of the questionnaire regarding knowledge of sun exposure related to vitamin D, random sampling was carried out on smokers and non-smokers, then 30 respondents were taken. Validity and reliability tests were carried out using SPSS software. The results of the validity test regarding knowledge of sun exposure related to vitamin D, obtained from each question item regarding knowledge of sun exposure related to sun exposure are valid (0.707) because the value of $r_{count} > 0.361$. So the results of the reliability test carried out at the level of knowledge of sun exposure related to vitamin D were declared reliable.

The results of the validity test regarding attitudes towards sun exposure related to vitamin D obtained from each question item regarding attitudes towards sun exposure related to sun exposure were declared valid (0.620) because the r value was > 0.361 . So the results of the reliability test carried out on the level of attitude towards sun exposure related to vitamin D were declared reliable.

3.2 Characteristics of Respondents

Respondents used in this study were 168 respondents. The average age of the respondents was 21.60 years. Most of the respondents had normal weight (137 of 168). Most of the respondents had a ratio value of FEV1/FVC < 0.7 (155 of 168) which indicated a decrease in lung function (Table 1).

Table 1: Frequency Distribution of Respondents Characteristics

Characteristics		Frequency (n=168)	Percentage (%)
Age (years)	18	10	5.95
	19	17	10.12
	20	20	11.90
	21	31	18.45
	22	32	19.05
	23	32	19.05
	24	15	8.93
	25	11	6.55
BMI (kg/m ²)	Thin ($\leq 18,5$)	20	11.90
	Normal (18,5- < 25)	137	81.55
	Overweight (25,0- < 27)	11	6.55
FEV1/FVC value	< 0.7	72	42.86
	≥ 0.7	96	57.14

3.3 Knowledge on sun exposure related to vitamin D

The profile of answers regarding knowledge on sun exposure related to vitamin D can be seen in Table 2. The knowledge classification was divided into good (≥ 9 points) and bad (< 9 points). Most of respondents had good level of knowledge (97 of 168). The results of the different test with chi-square test showed there was a relationship between the level of knowledge on sun exposure levels related to vitamin D and lung function (ratio FEV1/FVC) (P value (0.000) < 0.05) (Table 3).

Table 2: Profile of Knowledge Level Answers toward sun exposure related to vitamin D

No	Question	Frequency (n=168)	Percentage (%)
1.	Information about vitamin D	Ever heard	124
		Never heard	44
	What is known about vitamin D (**)	Vitamins from the sun	34
		Vitamins for bone growth	26
		Vitamins used for immunity	78
			73.81
			26.19
			88.23
			15.48
			46.43

	Don't know	30	17.86
2. Source of information about vitamin D (*)	Pharmacists/Nurses/Doctors	12	7.14
	Family	9	5.36
	Book	21	12.50
	School	31	18.45
	Internet	49	29.17
	Friend	32	19.05
	Don't know	14	8.33
3. Greatest source of vitamin D	Vitamins or Supplements	35	20.83
	Vegetable	30	17.86
	Sun	24	14.29
	Meat	6	3.57
	Egg	33	19.64
	Fish	22	13.09
	Don't know	18	10.71
4. Benefits of vitamin D	Bone growth and maintenance	91	54.17
	Regulating calcium and phosphorus levels in body	30	17.86
	Immune	33	19.64
	Don't know	14	8.33
5. Due to vitamin D deficiency (*)	Cancer	66	39.29
	Obesity	11	6.55
	Cholesterol increase	12	7.14
	Bone disease	60	35.71
	High blood pressure	24	14.29
	Don't know	8	4.76
6. Causes of the body lack of vitamin D (*)	Using an umbrella during the day	77	45.83
	Sunbathing on the beach	7	4.17
	Doing regular physical activity	22	13.10
	Using closed clothes	75	44.64
	Using sunscreen	56	33.33
	Don't know	12	7.14
7. The sun can help produce vitamin D	Agree	66	39.29
	Don't agree	58	34.52
	Don't know	44	26.19
Reason	Can be used for bone health	82	48.81
	The sun is the synthesis of vitamin D in body	86	51.19
8. Sunlight is harmful to the skin	Yes	86	51.19
	No	82	48.81
The reason (**)	Too hot	63	37.50
	Cause skin cancer if it's too long	29	17.26
	For fear of black	65	38.69
	Don't know	11	6.55
9. The best time for the body to be exposed to direct sunlight is at... until....	06.00–09.00 a.m	70	41.67
	07.00–09.00 a.m	40	23.81
	10.00 a.m–02.00 p.m	33	19.64
	Afternoon	25	14.88
10. A good time for the body to get vitamin D from sun exposure	5–15 minutes	51	30.36
	15–30 minutes	60	35.71
	30–60 minutes	39	23.21
	>1 hour	18	10.71
11. A good amount of SPF for the body	<15	58	34.52
	≥15	73	43.45
	Don't know	37	22.02

*) Respondent's answer can be more than one

**) Open Question

Table 3: Cross-tabulation of Knowledge toward sun exposure levels related to vitamin D

Knowledge level on sun exposure related to vitamin D		Lung Function		Frequency (n=168)	Chi-Square Test
Number of Questions	Category e	<0.7	≥ 0.7		
Correct					
≥9 points	Good	12	85	97	0.000

<9 points	Bad	60	11	71
		72	96	168

3.4 Attitude on sun exposure related to vitamin D

The profile of answers regarding attitude on sun exposure related to vitamin D can be seen in Table 4. The attitude classification was divided into good (≥ 7 points) and bad (< 7 points). Most of the respondents had good level of attitude (115 of 168). The results of the different test with the chi-square test showed that there was a relationship between the level of attitude on sun exposure levels related to vitamin D and lung function (ratio FEV1/FVC) (P value (0.000) < 0.05) (Table 5).

Table 4: Profile of Answer Level Attitude toward sun exposure related to vitamin D

No	Question	Frequency (n=168)	Percentage (%)
1.	Frequent trips or walks in direct sunlight	Yes	168
2.	Length per day you get sunlight (minutes)	5	26
		5–15	47
		20–30	63
		> 30	32
3.	Avoid direct sun exposure	Yes	111
		No	57
	If yes, why (**)	Avoid the heat or the sun	41
		Afraid of black	47
		Don't know	23
	If not the reason (**)	Sunlight is good for skin and bones	37
		Lots of outdoor activities	11
		Don't know	9
4.	Use skin protection equipment to avoid sun exposure	Yes	156
		No	12
	What type of protective equipment is used (**)	Jacket	82
		Sunblock	14
		Jacket and sunscreen	8
		Hat	52
5.	The reason you use protective equipment	Avoid black skin	90
		Avoid heat	72
		Because men are not afraid of heat	6
6.	Taking vitamin D supplements	Yes	0
		No	168
7.	The purpose of taking vitamin D supplements	Sufficient vitamin D needs	47
		Bone growth and maintenance	88
		Don't know	33
8.	Opinions about the need for vitamin D in the body	It's enough	89
		Not enough	79
	If it is sufficient, the reason (**)	Frequent exposure to the sun	46
		Often eat vegetables and drink milk	22
		Feeling never sick	13
		Give no reason	8
	If not sufficient, the reason (**)	Never feel pain	24
		Avoid the sun	38
		Give no reason	17
9.	Have an interest in knowing more about vitamin D	Yes	116
		No	52
	If yes, the reason	Increase knowledge and insight	66
		Vitamin D is important for the body	25
		More want to know about vitamin D	25

*) Respondent's answer can be more than one

**) Open Question

Table 5: Cross-tabulation of Attitude toward sun exposure levels related to vitamin D

Attitude level on sun exposure related to vitamin D		Lung Function		Frequency (n=168)	Chi-Square Test
Number of Questions Correct	Category Level of Attitude	<0.7	≥0.7		
≥ 9 points	Good	25	90	115	0.000
< 9 points	Bad	47	6	53	
		72	96	168	

3.5 Relationship Knowledge and Attitude on sun exposure related to vitamin D

The results of the different test with the chi-square test showed that there was a relationship between the level of knowledge to attitude on sun exposure levels related to vitamin D (P value (0.000)<0.05) (Table 6).

Table 6: Cross-tabulation of Knowledge and Attitude toward sun exposure related to vitamin D

Attitude level on sun exposure related to vitamin D	Knowledge level on sun exposure related to vitamin D		Frequency (n=168)	Chi-Square Test
	Good (≥9 points)	Bad (<9 points)		
Good (≥7 points)	80	17	97	0.000
Bad (<7 points)	35	36	71	
	115	53	168	

4. DISCUSSION

Age was the main factor that affects lung function disorders. Age was related to the aging process where the increasing age of a person, the greater the possibility of a decrease in lung function capacity. There was significant relationship between age and lung function capacity. In addition, with increasing age, the perception and mindset will develop, so that the knowledge gained was getting better [32- 34]. The measurement of the spirometer value carried out in FEV1/FVC value. The limitation of this study was that it did not measure blood levels of vitamin D, because there were several factors other than knowledge and attitudes that can affect lung function. Factors that can affect lung function include:

1. Age. Age appears to be a reinforcing factor. Based on the theory that age can affect knowledge, the older one gets, the easier it is to digest the information obtained. The results obtained in this study differ from the theory, where age does not affect knowledge of sun exposure.
2. Genetics, the influence of genetic factors on pulmonary function, as demonstrated mostly by FEV1 and FVC, has been investigated in several studies. FVC was taken as lung size and FEV1 was taken as airflow rate [35]. The most trusted genetic risk factor at present is a deficiency of 1-antitrypsin which is a major inhibitor of circulating serine proteases. 1-antitrypsin is a serum protein produced by the liver and normally found in the lungs to inhibit the destructive action of the neutrophil elastase enzyme on lung tissue. A decrease in the level of 1-antitrypsin to less than 35% of the normal value (150-350 mg/dL) causes reduced protection of lung parenchyma tissue, destruction of the adjacent alveolar walls, and finally causes a decrease and damage to the lung. The most common genetic variants of 1-antitrypsin are M, S and Z. The M allele's normal while the S and Z alleles are associated with defisiensi 1-antitrypsin deficiency. Moderate 1-antitrypsin deficiency is most often caused by the MS and MZ genotypes [36], [37].
3. Smoking, cigarette smoke can cause local damage to the respiratory tract, such as loss of ciliary function. Cilia function as a deterrent to foreign objects, so that foreign objects and other pollutants will not easily enter the lungs. This decrease in ciliary function increases the risk of lung function disorders, because dust and pollutants can easily enter the lungs. This theory clearly states that cigarette smoke can cause a decrease in lung function, so that pulmonary function disorders are not only experienced by active smokers and former smokers, but can also be experienced by passive smokers [38], [39].

Factors that influence the response profile of the level of knowledge and attitudes towards sun exposure related to vitamin D in respondents:

1. Respondents who answered that they'd heard about vitamin D were 124 of 168. Vitamin D was

used for bone growth and respondents who knew that vitamin D was for immunity were 10.26%. The mechanism of vitamin D in bone formation and bone maintenance is by activating calcitriol or 1,25-dihydroxycholecalciferol from 25(OH)D3 to be 10 times more active than vitamin D3 in kidney. This calcitriol will increase the absorption of calcium and phosphorus in bones [12], [40]. At the age of respondent, more information about vitamin D was obtained from the internet (49 of 168) and friends (32 of 168).

2. Most of respondents answered that the largest source of vitamin D came from vitamin D supplements (35 of 168). The answer wasn't correct because the largest source of vitamin D from sun exposure besides vitamins and supplements. Vitamin D2 or ergocalciferol can be obtained from supplements and food. Meanwhile, vitamin D3 was produced from the synthesis of 7-dehydrocholesterol which was obtained from sunlight and can be obtained by consuming milk, supplements, yogurt, fish oil, cereals and margarine [12], [41].

3. Respondents' answers said that the benefits of vitamin D are for bone health (91 of 168). Benefits of vitamin D is used for growth and maintenance of bones, vitamin D is used to regulate calcium and phosphorus levels in the body, and vitamin D is used for immunity. Vitamin D which is produced from sunlight, namely UVB rays, has benefits for bone formation and reduces the risk of diseases including arthritis, skin cancer and autoimmune diseases [12]. The mechanism of vitamin D in bone formation and bone maintenance is by activating calcitriol or 1,25-dihydroxycholecalciferol from 25(OH)D3 to be 10 times more active than vitamin D3 in the kidney. This calcitriol will increase the absorption of calcium and phosphorus in bones [42].

4. The result of vitamin D deficiency's the occurrence of rickets in children which can be characterized by early symptoms such as osteomalacia, swollen bones forming X and O. There's a close relationship between vitamin D deficiency and decreased lung function. The mechanism of vitamin D in bone formation and bone maintenance is by activating calcitriol or 1,25-dihydroxycholecalciferol from 25(OH)D3 to be 10 times more active than vitamin D3 in kidney. This calcitriol will increase the absorption of calcium and phosphorus in bones [42].

5. Any protective device that interferes with the penetration of UVB radiation can affect the synthesis of vitamin D3 [43]. As sunscreen, general window glass at home or car and clothing, all of them effectively block UVB radiation even in summer, people who work indoors, wear extensive clothing, regularly use sunscreen, dark skin, obesity, aged Continued or consciously avoiding the sun will risk vitamin D deficiency [44], [45]. Sun exposure can be used to help body produce vitamin D in the amount it needs each day. However, for fear of getting skin cancer, most people avoid sun exposure. To prevent vitamin D deficiency, one should spend 15 to 20 minutes daily in the sun with 40% of the skin surface exposed [46].

6. Most respondents said that the best time to be exposed to the sun is 06.00-09.00 a.m (70 of 168) with a duration of 15-30 minutes (60 of 168). Exposure to direct sunlight can be harmful and not harmful, where exposure to sunlight can harm the skin if exposed for too long, triggering skin cancer and exposure to sunlight that does not harm the skin can be used to meet the needs of vitamin D in the body [47]. A good time for the skin to get vitamin D from direct sunlight is 15-30 minutes, because if the body is exposed to excessive sunlight it can trigger skin cancer [48], [49]. Exposure to abundant sunlight with high intensity can cause skin hyperpigmentation so that the skin becomes dull and scaly and can even increase the risk of skin cancer. These effects're mainly caused by UV A and B rays. In small amounts, UV-B radiation's beneficial for the synthesis of vitamin D in the body, but excessive exposure to these rays can cause skin redness/burning and harmful effects of synthesis. free radicals that trigger erythema and cataracts [48,49,50].

7. If the skin's exposed to excessive sunlight, there will be high cumulative ultraviolet (UV) radiation that can damage skin cells, affect the normal growth and appearance of the skin and cause acute skin damage, including aging and burning. In addition, more complicated chronic problems can occur with long-

term exposure, such as skin aging and skin cancer [48- 50]. UV radiation is also responsible for significant eye damage, particularly cataract formation. Sun Protection Factor (SPF) which is good for the body is 15. With an SPF of 15, it's said to be able to absorb 99% of UVB radiation, so that it can reduce the synthesis of vitamin D3 in the skin [51].

8. There's a risk of vitamin D deficiency if a person intentionally avoids sun exposure, because daily sun exposure helps the human body to produce vitamin D in the required amount. The results showed there're still many people who were active outside the room compared to indoors [52], [53].

5. CONCLUSION

There was a relationship between the level of knowledge and attitude toward sun exposure levels related to vitamin D and lung function. And there was a relationship between the level of knowledge to attitude on sun exposure levels related to vitamin D.

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7. CONFLICT OF INTEREST

The authors have no conflicts of interest regarding this investigation.

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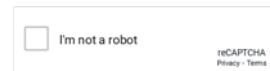
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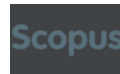
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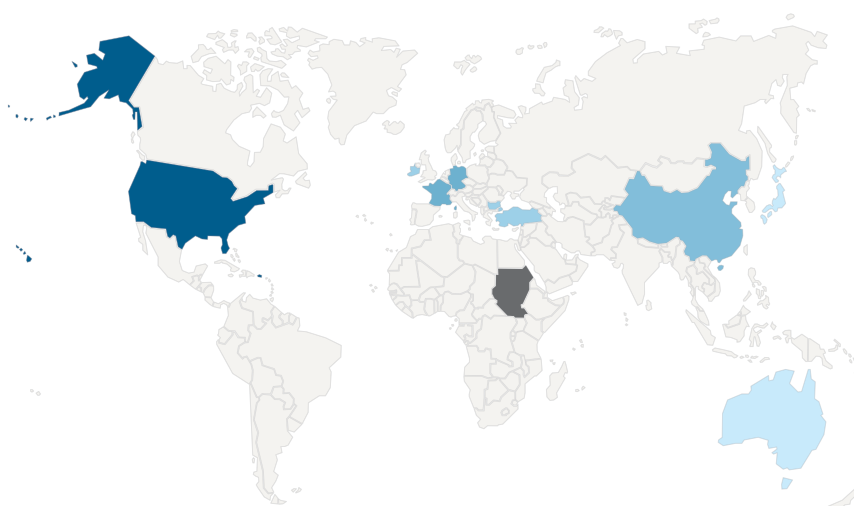
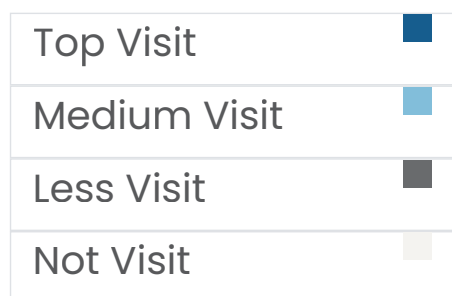
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Indonesia is a country with a tropical climate with sun exposure throughout the season, because sunlight is the largest source of vitamin D. The risk of vitamin D deficiency can lead to respiratory problems. With good self-management, of course, adequate knowledge and attitudes are needed in overcoming various individual health problems. The purpose was to influence knowledge and attitudes towards sun exposure in meeting the need for vitamin D to improve lung function in healthy respondents without chronic respiratory disorders. The research will be conducted using a cross sectional design, in May-August 2019. The variables were knowledge and attitudes towards sun exposure related to the risk of vitamin D deficiency and lung function by forced expiratory volume in 1 second (FEV1) and forced vital capacity (FVC). Respondents used in this study were 168 respondents. Most of the respondents had good level of knowledge (97 of 168), and most of the respondents had good level of attitude (115 of 168). There was relationship between the level of knowledge ($p=0.000$) and attitude ($p=0.000$) toward sun exposure levels related to vitamin D and lung function. And there was relationship between the level of knowledge to attitude on sun exposure levels related to vitamin D ($p=0.000$). Therefore, knowledge and attitudes on sun exposure related to vitamin D were important concerns to maintain healthy lung function.

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Effect of Knowledge and Attitude toward Sun Exposure Related Vitamin D to Lung Function

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Attitude, FEV1/FVC, knowledge, sun exposure, vitamin D

ABSTRACT

Indonesia is a country with ²⁵tropical climate with sun exposure throughout the season, because sunlight is the largest source of vitamin D. The risk of vitamin D deficiency can lead to respiratory problems. With good self-management, of course, adequate knowledge and attitudes are needed in overcoming various individual health problems. The purpose was to influence knowledge and attitudes towards sun exposure in meeting the need for vitamin D to improve lung function in healthy respondents without chronic respiratory disorders. The research will be conducted using a cross sectional design, in May ⁸ugust 2019. The variables were ⁸nowledge and attitudes towards sun exposure related to the risk of vitamin D deficiency and lung function by forced expiratory volume in 1 second (FEV1) and forced vital capacity (FVC). Respondents used in this study were 168 respondents. Most of the respondents had good level of knowledge (97 of 168), and ⁹ost of the respondents had good level of attitude (115 of 168). There was relationship between the level of knowledge (p=0.000) and attitude (p=0.000) toward sun exposure levels related to vitamin D and lung function. And there was relationship between the level of knowledge to attitude on sun exposure levels related to vitamin D (p=0.000). Therefore, knowledge and attitudes on sun exposure related to vitamin D were important concerns to maintain healthy lung function.

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1. INTRODUCTION

Indonesia is in a tropical climate region with sun exposure throughout the season. Sunlight can produce ultraviolet rays that cannot be seen by the eyes directly, but have benefits for the body [1], [2]. The effects that can be felt from sun exposure can be seen in the short term and long term. Effects that can be caused in the short term such as erythema, photosensitivity and pigmentation are ¹⁴ute. The long-term effects include skin cancer and premature aging [3]. Previous research showed that vitamin D levels were less than 50 nmol/L in participants who still had Indian, Malay and Chinese ancestry [4]. Research in Indonesia shows ²⁴s that many people experience vitamin D deficiency from various backgrounds and ages [2], [5- 8]. Sun exposure is the largest source of vitamin D which is very beneficial for the body apart from food sources

and supplements [9]. Vitamin D consists of two types, namely D2 or ergocalciferol and vitamin D3 or cholecalciferol. Vitamin D2 or ergocalciferol can be obtained from supplements and food [10]. Vitamin D3 or cholecalciferol is produced from the synthesis of 7-dehydrocholesterol obtained from sunlight and can be obtained by consuming milk, supplements, yogurt, fish oil, cereals and margarine. Vitamin D which is produced from sunlight, namely UVB rays, has benefits for bone formation and reduces the risk of diseases including arthritis, skin cancer and autoimmune diseases [11], [12].

Although Indonesia is a country that has a great opportunity to be exposed to sunlight, it has a low risk of vitamin D status. Low levels of vitamin D can be influenced by skin color, age, and gender [13]. The risk of vitamin D deficiency can lead to respiratory problems. There's a relationship between vitamin D deficiency related to respiratory disorders such as chronic obstructive pulmonary disease (COPD), tuberculosis and asthma. Respiratory disorders that occur in a person are caused by the immune system in the body inhibiting the production of cytokines, thereby reducing inflammation [14- 16]. Vitamin D which is present in one of the respiratory systems, namely the lungs, will have the effect of changing T cell activity, increasing the secretion of antimicrobial cathelicidin peptide, producing chemokines and inhibiting dendritic cell activity. This effect is used to fight infections that can cause lung diseases. If the level of vitamin D in smokers is low, the damage to lung function will be faster [15- 17].

Respiratory disorders that occur greatly affect the quality of life of every affected community [18]. So to improve the quality of life of the community in the health sector and in an effort to prevent the incidence of illness, the government through the health department plans a healthy community movement by making 7 main agendas such as maintaining environmental cleanliness, consuming fruit and vegetables, not consuming alcohol, not smoking, doing physical activity, check their health regularly and maintain the cleanliness of the latrines [19]. This program will never be implemented properly without self-management from within each individual such as controlling thoughts, emotions, behavior and being able to motivate oneself to achieve goals in improving one's own health [20]. With good self-management, of course, adequate knowledge and attitudes are needed in overcoming various individual health problems [21]. The individuals have less knowledge and attitudes towards health problems. The relationship between knowledge and attitudes related to decreased lung function is very low due to several factors such as education level and living environment [22]. Therefore, this study aimed to influence knowledge and attitudes towards sun exposure in meeting the need for vitamin D to improve lung function in healthy respondents without chronic respiratory disorders.

2. METHODS

The research will be conducted using a cross sectional design, by giving a questionnaire to each respondent to measure differences in knowledge and attitudes related to sun exposure in May until August 2019. The variables of this study were the level of knowledge and attitudes towards sun exposure related to the risk of vitamin D deficiency and lung function by forced expiratory volume in 1 second (FEV1) and forced vital capacity (FVC). This research had received ethical test No.004-OL/KE/V/2019 from Universitas Surabaya. Lung function referred to in this study is how well the ability to move air in and out of the lungs and how well oxygen enters the body. Lung function can be measured through spirometry measurements by looking at the FEV1/FVC value, where an FEV1 value of <70% can be said to have impaired lung function. The value of FEV1/FVC is good if the results show ≥ 0.7 [23], [24]. The requirements that must be considered by each respondent before pulmonary function tests are carried out are as follows: No smoking for an hour before test; Didn't consume alcohol for the previous 4 hours before test; Not doing sports activities for the previous 30 minutes before test; Didn't eat for 2 hours before test; Didn't wear tight clothes; and No medication was taken before [25]. Measurement of lung function using a handheld spirometer where body

mass index (BMI) data in the form of weight and height and respondent data in the form of gender, age, smoker or not are entered into the spirometer. Then the respondent was asked to stand or sit up straight, then the respondent is asked to inhale as deeply as possible through the mouth while closing the nose, then the tube contained in the spirometer is inserted into the mouth, making sure the lips tightly cover the tube wall and the tongue does not cover the tube opening, then breathe out. Exhale as hard and fast as possible in one second until there was no air left in the lungs. Examination with a spirometer can be done 3 times or more to get more accurate results. The results of the spirometer measurement from the respondent will determine whether the respondent has respiratory problems or does not experience respiratory problems based on the FEV1 value. FEV1 value <70% already indicates respiratory problems. So if the value of FEV1 <70%, then it is categorized in the group of respiratory disorders and FEV1 70% is categorized in the group that does not experience respiratory disorders [24], [26], [27].

The knowledge data collection was carried out using a questionnaire that has been used in previous studies [8], [29- 31]. The questions in the questionnaire consist of 11 questions that were structured in the form of open-ended questions and closed-ended questions. The type of data used in this variable used ordinal variable. The assessment of the level of knowledge of the respondents was carried out by calculating the total score of correct answers to each question, each correct answer will be given a score of 1, so that the maximum total correct answer of the respondent is a score of 11. In this study the level of knowledge was categorized into 2, namely the level of knowledge was high if the number was correct 6 items and low level of knowledge if the number of correct answers <6 items.

The attitude data collection was carried out using a questionnaire that has been used in previous studies [8], [29- 31]. The questions in the questionnaire consist of 9 questions that were used to determine attitudes towards sun exposure. The types of data used in this study were ordinal and nominal variables. In this study, the assessment of attitudes related to sun exposure was divided into 2 categories consisting of good attitudes and bad attitudes. Each question asked will be given a score of 2 if the research subject had an attitude that tends to be at risk of vitamin D deficiency. This questionnaire can produce a maximum score of 18 points, if the respondent's answer produces 9 points then it can be categorized as a good attitude, but if >9 points then respondent's attitude was categorized as bad.

The research subjects were young people (≥ 18 years) as students in the Rungkut District, Surabaya. Sampling technique was done by purposive and consecutive sampling method. The sample size formula that will be used in this study was Lemeshow because it does not know the previous sample population. So the minimum respondents who will be used in the study are 62 respondents. In this study, the questionnaire used was a previous research questionnaire which had been validated twice. The first validation used was content validation, where the questionnaire that has been obtained from the journal was translated into Indonesian first. The second validation was construct validation, where the questionnaire will be distributed to 30 students at the University of Surabaya after which data processing will be carried out using SPSS version 24 software. Reliability was the stability of the results to the extent that a questionnaire that has been measured repeatedly with any method will produce the same results. Reliability was carried out on 20-30 subjects and not included in the sample, then it would be analyzed using the Cronbach's alpha method in the SPSS software.

Data analysis to examine the relationship of knowledge and attitudes on sun exposure related to vitamin D on lung function (ratio FEV1/FVC) using chi-square test. Then the test was also used to analyze the relationship between knowledge and attitudes on sun exposure levels related to vitamin D.

3. RESULTS

3.1 Validity and reliability test results

In testing the validity and reliability of the questionnaire regarding knowledge of sun exposure related to vitamin D, random sampling³⁴ was carried out on smokers and non-smokers, then 30 respondents were taken. Validity and reliability tests were carried out using SPSS software. The results of the validity test regarding knowledge of sun exposure related to vitamin D, obtained from each question item regarding knowledge of sun exposure related to sun exposure are valid (0.707) because the value of $r_{count} > 0.361$. So the results of the reliability test carried out at the level of knowledge of sun exposure related to vitamin D were declared reliable.

The results of the validity test regarding attitudes towards sun exposure related to vitamin D obtained from each question item regarding attitudes towards sun exposure related to sun exposure were declared valid (0.620) because the r value was > 0.361 . So the results of the reliability test carried out on the level of attitude towards sun exposure related to vitamin D were declared reliable.

3.2 Characteristics of Respondents

Respondents used in this study were 168 respondents. The average age of the respondents was 21.60 years. Most of the respondents had normal weight (137 of 168). Most of the respondents had a ratio value of FEV1/FVC < 0.7 (155 of 168) which indicated a decrease in lung function (Table 1).

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Table 1: Frequency Distribution of Respondents Characteristics

Characteristics		Frequency (n=168)	Percentage (%)
Age (years)	18	10	5.95
	19	17	10.12
	20	20	11.90
	21	31	18.45
	22	32	19.05
	23	32	19.05
	24	15	8.93
	25	11	6.55
BMI (kg/m ²)	Thin ($\leq 18,5$)	20	11.90
	Normal (18,5- < 25)	137	81.55
	Overweight (25,0- < 27)	11	6.55
FEV1/FVC value	< 0.7	72	42.86
	≥ 0.7	96	57.14

3.3 Knowledge on sun exposure related to vitamin D

The profile of answers regarding knowledge on sun exposure related to vitamin D can be seen in Table 2. The knowledge classification was divided into good (≥ 9 points) and bad (< 9 points). Most of respondents had good level of knowledge (97 of 168). The results of the different test with chi-square test showed there was a relationship between⁴² level of knowledge on sun exposure levels related to vitamin D and lung function (ratio FEV1/FVC) (P value (0.000) < 0.05) (Table 3).

Table 2: Profile of Knowledge Level Answers toward sun exposure related to vitamin D

No	Question		Frequency (n=168)	Percentage (%)
1.	Information about vitamin D	Ever heard	124	73.81
		Never heard	44	26.19
	What is known about vitamin D (**)	Vitamins from the sun	34	88.23
		Vitamins for bone growth	26	15.48
		Vitamins used for immunity	78	46.43

	Don't know	30	17.86
2. Source of information about vitamin D (*)	Pharmacists/Nurses/Doctors	12	7.14
	Family	9	5.36
	Book	21	12.50
	School	31	18.45
	Internet	49	29.17
	Friend	32	19.05
	Don't know	14	8.33
3. Greatest source of vitamin D	Vitamins or Supplements	35	20.83
	Vegetable	30	17.86
	Sun	24	14.29
	Meat	6	3.57
	Egg	33	19.64
	Fish	22	13.09
	Don't know	18	10.71
4. Benefits of vitamin D	Bone growth and maintenance	91	54.17
	Regulating calcium and phosphorus levels in body	30	17.86
	Immune	33	19.64
	Don't know	14	8.33
5. Due to vitamin D deficiency (*)	Cancer	66	39.29
	Obesity	11	6.55
	Cholesterol increase	12	7.14
	Bone disease	60	35.71
	High blood pressure	24	14.29
	Don't know	8	4.76
6. Causes of the body lack of vitamin D (*)	Using an umbrella during the day	77	45.83
	Sunbathing on the beach	7	4.17
	Doing regular physical activity	22	13.10
	Using closed clothes	75	44.64
	Using sunscreen	56	33.33
	Don't know	12	7.14
7. The sun can help produce vitamin D	Agree	66	39.29
	Don't agree	58	34.52
	Don't know	44	26.19
Reason	Can be used for bone health	82	48.81
	The sun is the synthesis of vitamin D in body	86	51.19
8. Sunlight is harmful to the skin	Yes	86	51.19
	No	82	48.81
The reason (**)	Too hot	63	37.50
	Cause skin cancer if it's too long	29	17.26
	For fear of black	65	38.69
	Don't know	11	6.55
9. The best time for the body to be exposed to direct sunlight is at... until....	06.00–09.00 a.m	70	41.67
	07.00–09.00 a.m	40	23.81
	10.00 a.m–02.00 p.m	33	19.64
	Afternoon	25	14.88
10. A good time for the body to get vitamin D from sun exposure	5–15 minutes	51	30.36
	15–30 minutes	60	35.71
	30–60 minutes	39	23.21
	>1 hour	18	10.71
11. A good amount of SPF for the body	<15	58	34.52
	≥15	73	43.45
	Don't know	37	22.02

*) Respondent's answer can be more than one

**) Open Question

Table 3: Cross-tabulation of Knowledge toward sun exposure levels related to vitamin D

Knowledge level on sun exposure related to vitamin D		Lung Function		Frequency (n=168)	Chi-Square Test
Number of Questions	Category e	<0.7	≥ 0.7		
Correct					
≥9 points	Good	12	85	97	0.000

<9 points	Bad	60	11	71
		72	96	168

3.4 Attitude on sun exposure related to vitamin D

The profile of answers regarding attitude on sun exposure related to vitamin D can be seen in Table 4. The attitude classification was divided into good (≥ 7 points) and bad (< 7 points). Most of the respondents had good level of attitude (115 of 168). The results of the different test with the chi-square test showed that there was a relationship between the level of attitude on sun exposure levels related to vitamin D and lung function (ratio FEV1/FVC) (P value (0.000) < 0.05) (Table 5).

Table 4: Profile of Answer Level Attitude toward sun exposure related to vitamin D

No	Question	Frequency (n=168)	Percentage (%)
1.	Frequent trips or walks in direct sunlight	Yes	168
2.	Length per day you get sunlight (minutes)	5	26
	5–15	47	27.98
	20–30	63	37.50
	> 30	32	19.05
3.	Avoid direct sun exposure	Yes	111
	No	57	33.93
	If yes, why (**)	Avoid the heat or the sun	41
		Afraid of black	47
		Don't know	23
	If not the reason (**)	Sunlight is good for skin and bones	37
		Lots of outdoor activities	11
		Don't know	9
4.	Use skin protection equipment to avoid sun exposure	Yes	156
	No	12	7.14
	What type of protective equipment is used (**)	Jacket	82
		Sunblock	14
		Jacket and sunscreen	8
		Hat	52
5.	The reason you use protective equipment	Avoid black skin	90
		Avoid heat	72
		Because men are not afraid of heat	6
6.	Taking vitamin D supplements	Yes	0
	No	168	100
7.	The purpose of taking vitamin D supplements	Sufficient vitamin D needs	47
		Bone growth and maintenance	88
		Don't know	33
8.	Opinions about the need for vitamin D in the body	It's enough	89
		Not enough	79
	If it is sufficient, the reason (**)	Frequent exposure to the sun	46
		Often eat vegetables and drink milk	22
		Feeling never sick	13
		Give no reason	8
	If not sufficient, the reason (**)	Never feel pain	24
		Avoid the sun	38
		Give no reason	17
9.	Have an interest in knowing more about vitamin D	Yes	116
	No	52	30.95
	If yes, the reason	Increase knowledge and insight	66
		Vitamin D is important for the body	25
		More want to know about vitamin D	25

*) Respondent's answer can be more than one

**) Open Question

Table 5: Cross-tabulation of Attitude toward sun exposure levels related to vitamin D

Attitude level on sun exposure related to vitamin D		Lung Function		Frequency (n=168)	Chi-Square Test
Number of Questions	Category Level of Attitude	<0.7	≥0.7		
Correct					
≥ 9 points	Good	25	90	115	0.000
< 9 points	Bad	47	6	53	
		72	96	168	

3.3 Relationship Knowledge and Attitude on sun exposure related to vitamin D

The results of the different test with the chi-square test showed that there was a relationship between the level of knowledge to attitude on sun exposure levels related to vitamin D (P value (0.000)<0.05) (Table 6).

Table 6: Cross-tabulation of Knowledge and Attitude toward sun exposure related to vitamin D

Attitude level on sun exposure related to vitamin D	Knowledge level on sun exposure related to vitamin D		Frequency (n=168)	Chi-Square Test
	Good (≥9 points)	Bad (<9 points)		
Good (≥7 points)	80	17	97	0.000
Bad (<7 points)	35	36	71	
	115	53	168	

4. DISCUSSION

Age was the main factor that affects lung function disorders. Age was related to the aging process where the increasing age of a person, the greater the possibility of a decrease in lung function capacity. There was significant relationship between age and lung function capacity. In addition, with increasing age, the perception and mindset will develop, so that the knowledge gained was getting better [32- 34]. The measurement of the spirometer value carried out in FEV1/FVC value. The limitation of this study was that it did not measure blood levels of vitamin D, because there were several factors other than knowledge and attitudes that can affect lung function. Factors that can affect lung function include:

1. Age. Age appears to be a reinforcing factor. Based on the theory that age can affect knowledge, the older one gets, the easier it is to digest the information obtained. The results obtained in this study differ from the theory, where age does not affect knowledge of sun exposure.
2. Genetics, the influence of genetic factors on pulmonary function, as demonstrated mostly by FEV1 and FVC, has been investigated in several studies. FVC was taken as lung size and FEV1 was taken as airflow rate [35]. The most trusted genetic risk factor at present is a deficiency of 1-antitrypsin which is a major inhibitor of circulating serine proteases. 1-antitrypsin is a serum protein produced by the liver and normally found in the lungs to inhibit the destructive action of the neutrophil elastase enzyme on lung tissue. A decrease in the level of 1-antitrypsin to less than 35% of the normal value (150-350 mg/dL) causes reduced protection of lung parenchyma tissue, destruction of the adjacent alveolar walls, and finally causes a decrease and damage to the lung. The most common genetic variants of 1-antitrypsin are M, S and Z. The M allele's normal while the S and Z alleles are associated with deficiency 1-antitrypsin deficiency. Moderate 1-antitrypsin deficiency is most often caused by the MS and MZ genotypes [36], [37].
3. Smoking, cigarette smoke can cause local damage to the respiratory tract, such as loss of ciliary function. Cilia function as a deterrent to foreign objects, so that foreign objects and other pollutants will not easily enter the lungs. This decrease in ciliary function increases the risk of lung function disorders, because dust and pollutants can easily enter the lungs. This theory clearly states that cigarette smoke can cause a decrease in lung function, so that pulmonary function disorders are not only experienced by active smokers and former smokers, but can also be experienced by passive smokers [38], [39].

Factors that influence the response profile of the level of knowledge and attitudes towards sun exposure related to vitamin D in respondents:

1. Respondents who answered that they'd heard about vitamin D were 124 of 168. Vitamin D was

used for bone growth and respondents who knew that vitamin D was for immunity were 10.26%. The mechanism of vitamin D in bone formation and bone maintenance is by activating calcitriol or 1,25-dihydroxycholecalciferol from 25(OH)D₃ to be 10 times more active than vitamin D₃ in kidney. This calcitriol will increase the absorption of calcium and phosphorus in bones [12], [40]. At the age of respondent, more information about vitamin D was obtained from the internet (49 of 168) and friends (32 of 168).

2. Most of respondents answered that the largest source of vitamin D came from vitamin D supplements (35 of 168). The answer wasn't correct because the largest source of vitamin D from sun exposure besides vitamins and supplements. Vitamin D₂ or ergocalciferol can be obtained from supplements and food. Meanwhile, vitamin D₃ was produced from the synthesis of 7-dehydrocholesterol which was obtained from sunlight and can be obtained by consuming milk, supplements, yogurt, fish oil, cereals and margarine [12], [41].

3. Respondents' answers said that the benefits of vitamin D are for bone health (91 of 168). Benefits of vitamin D is used for growth and maintenance of bones, vitamin D is used to regulate calcium and phosphorus levels in the body, and vitamin D is used for immunity. Vitamin D which is produced from sunlight, namely UVB rays, has benefits for bone formation and reduces the risk of diseases including arthritis, skin cancer and autoimmune diseases [12]. The mechanism of vitamin D in bone formation and bone maintenance is by activating calcitriol or 1,25-dihydroxycholecalciferol from 25(OH)D₃ to be 10 times more active than vitamin D₃ in the kidney. This calcitriol will increase the absorption of calcium and phosphorus in bones [42].

4. The result of vitamin D deficiency's the occurrence of rickets in children which can be characterized by early symptoms such as osteomalacia, swollen bones forming X and O. There's a close relationship between vitamin D deficiency and decreased lung function. The mechanism of vitamin D in bone formation and bone maintenance is by activating calcitriol or 1,25-dihydroxycholecalciferol from 25(OH)D₃ to be 10 times more active than vitamin D₃ in kidney. This calcitriol will increase the absorption of calcium and phosphorus in bones [42].

5. Any protective device that interferes with the penetration of UV radiation can affect the synthesis of vitamin D₃ [43]. As sunscreen, general window glass at home or car and clothing, all of them effectively block UVB radiation even in summer, people who work indoors, wear extensive clothing, regularly use sunscreen, dark skin, obesity, aged Continued or consciously avoiding the sun will risk vitamin D deficiency [44], [45]. Sun exposure can be used to help body produce vitamin D in the amount it needs each day. However, for fear of getting skin cancer, most people avoid sun exposure. To prevent vitamin D deficiency, one should spend 15 to 20 minutes daily in the sun with 40% of the skin surface exposed [46].

6. Most respondents said that the best time to be exposed to the sun is 06.00-09.00 a.m (70 of 168) with a duration of 15-30 minutes (60 of 168). Exposure to direct sunlight can be harmful and not harmful, where exposure to sunlight can harm the skin if exposed for too long, triggering skin cancer and exposure to sunlight that does not harm the skin can be used to meet the needs of vitamin D in the body [47]. A good time for the skin to get vitamin D from direct sunlight is 15-30 minutes, because if the body is exposed to excessive sunlight it can trigger skin cancer [48], [49]. Exposure to abundant sunlight with high intensity can cause skin hyperpigmentation so that the skin becomes dull and scaly and can even increase the risk of skin cancer. These effects're mainly caused by UV A and B rays. In small amounts, UV-B radiation's beneficial for the synthesis of vitamin D in the body, but excessive exposure to these rays can cause skin redness/burning and harmful effects of synthesis. free radicals that trigger erythema and cataracts [48,49,50].

7. If the skin's exposed to excessive sunlight, there will be high cumulative ultraviolet (UV) radiation that can damage skin cells, affect the normal growth and appearance of the skin and cause acute skin damage, including aging and burning. In addition, more complicated chronic problems can occur with long-

term exposure, such as skin aging and skin cancer [48- 50]. UV radiation is also responsible for significant eye damage, particularly cataract formation. Sun Protection Factor (SPF) which is good for the body is 15. With an SPF of 15, it's said to be able to absorb 99% of UVB radiation, so that it can reduce the synthesis of vitamin D3 in the skin [51].

There's a risk of vitamin D deficiency if a person intentionally avoids sun exposure, because daily sun exposure helps the human body to produce vitamin D in the required amount. The results showed there're still many people who were active outside the room compared to indoors [52], [53].

CONCLUSION

There was a relationship between the level of knowledge and attitude toward sun exposure levels related to vitamin D and lung function. And there was a relationship between the level of knowledge to attitude on sun exposure levels related to vitamin D.

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CONFLICT OF INTEREST

The authors have no conflicts of interest regarding this investigation.

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